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(54) Abstract Title: **Altering images in locations selected to form a unique pattern**

(57) A method of identifying a copy of an audio-visual program comprising the steps of selecting locations in each copy of the program such that the locations form a unique pattern in each copy and altering images appearing in the selected locations. The altering step may include shifting the image, altering all images within a scene or introducing artefacts at the selected locations. The pattern of locations may be coded to form a digital representation of a number unique to the copy in which it appears. Means to record names of recipients of particular copies to allow tracing of pirate copies may be provided.
Also described is a system for applying security codes to a moving picture wherein information comprising a plurality of separate coded symbols is recorded in a separate frame of the moving picture and a system for detecting counterfeit copies in such a system.

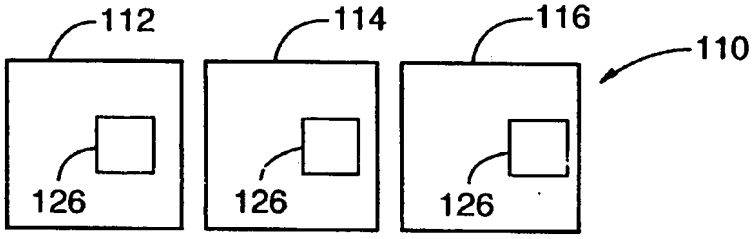

FIG.11

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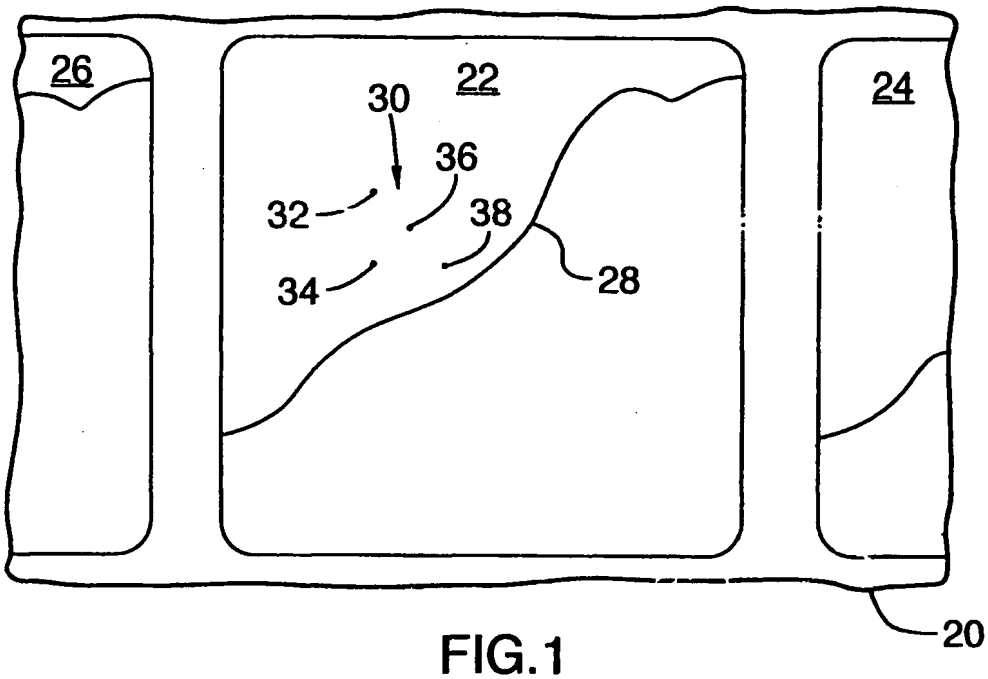

FIG.1

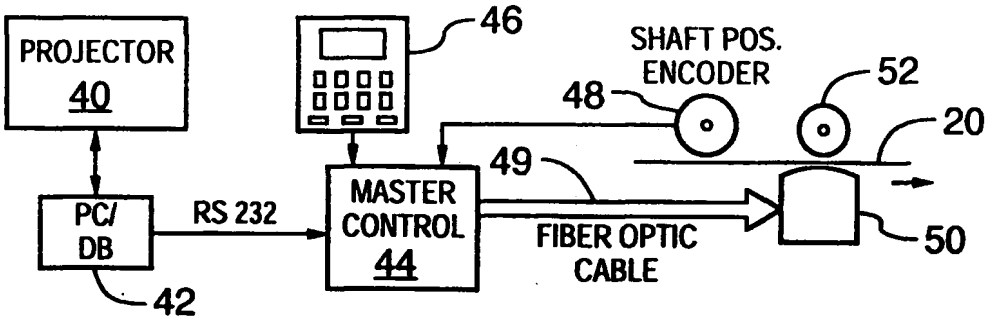

FIG.2

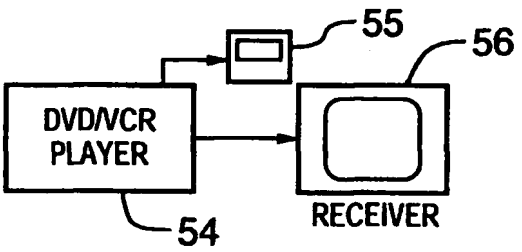

FIG.3

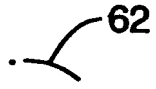

FIG.4

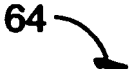

FIG.5

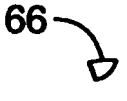

FIG.6

FIG.6A

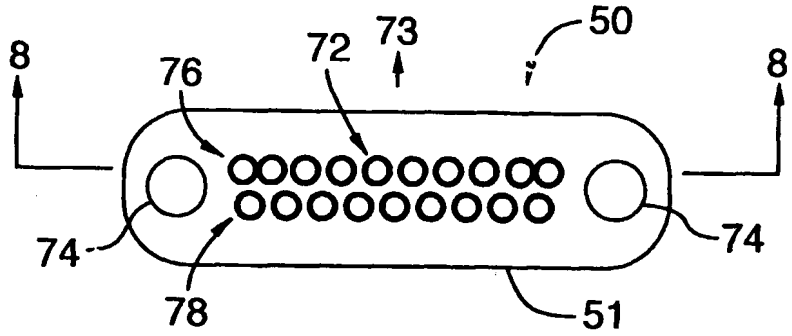

FIG.7

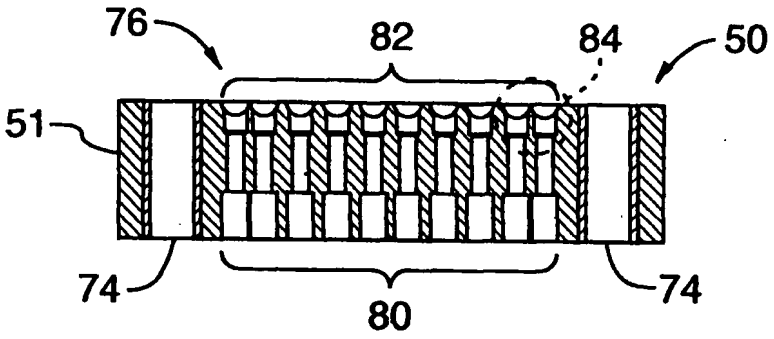

FIG.8

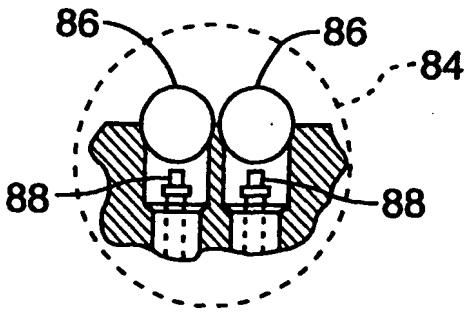

FIG.9

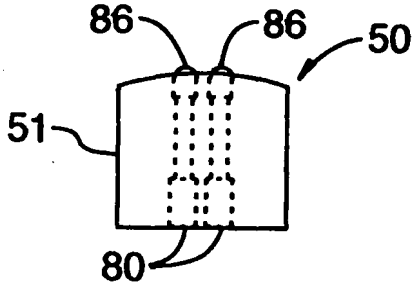

FIG.10

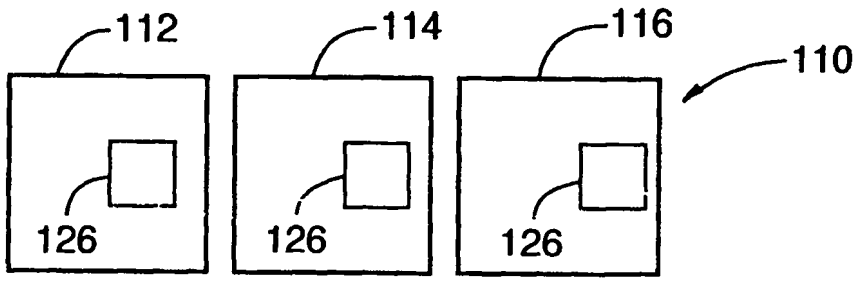

FIG.11

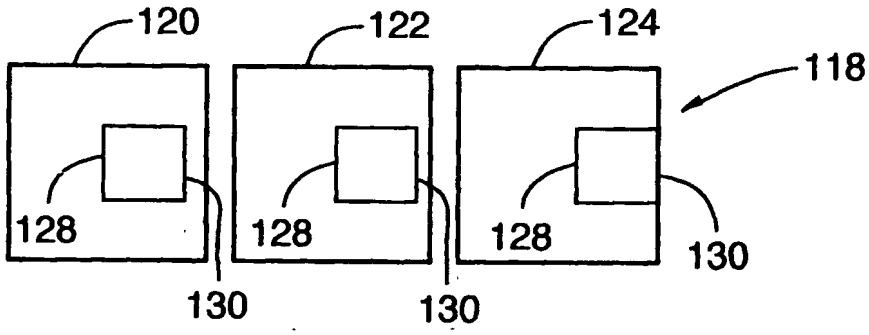

FIG.12

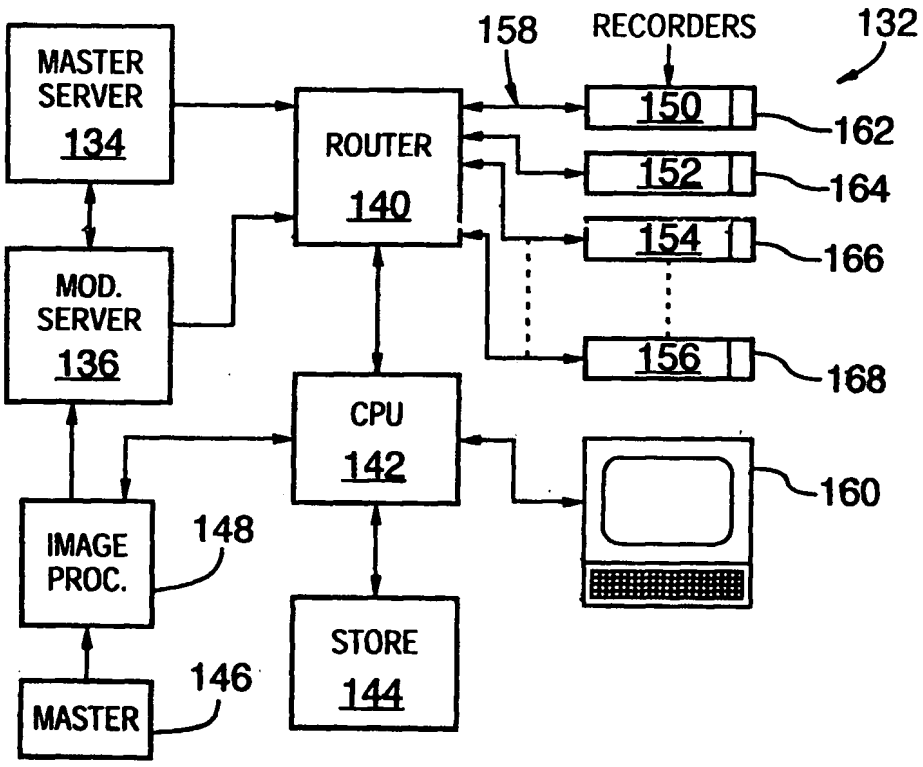

FIG.13

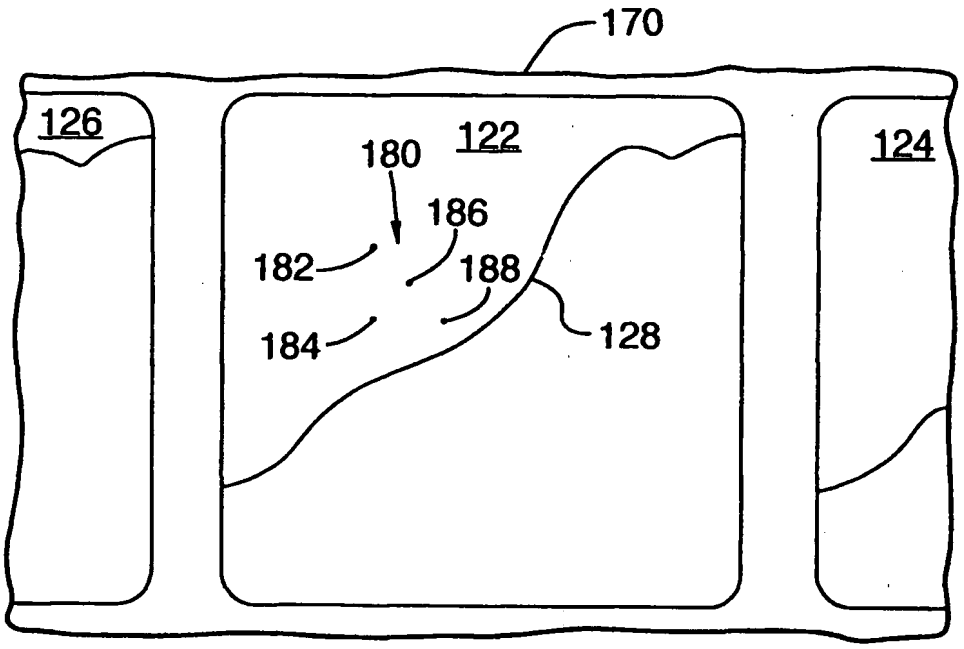

FIG.14

PROGRAM ENCODING AND COUNTERFEIT TRACKING SYSTEM AND METHOD

This invention relates to the encoding of audio-visual programs such as motion pictures and the tracking of counterfeit program copies, particularly counterfeit copies made from releases of a motion picture in video form.

"Motion picture", as that term is used herein, includes any type of program material using moving images as a medium of expression. It can include episodes of broadcast television programs, corporate events, as well as "movies", etc.

When a new movie is released, it usually is released in both film and video versions. The first copies, both film and video copies, usually are "screeners" sent to studio executives, advertising agencies, Motion Picture Academy Members and others. Later, film copies are sent to theaters and video copies are sent to airlines and hotels, then to pay-per-view distributors, and, finally, to free television broadcasters.

The production and sale of counterfeit copies of motion pictures is a serious problem of long standing. Counterfeit copies of new motion pictures sometimes are sold to the public even before the motion picture has been released by the motion picture studio. These counterfeit copies are hard to trace, and it is a difficult job to identify and bring the counterfeiters to justice.

A particularly crude but effective type of counterfeiting of film version of movies is the use of a video camera to copy a motion picture from a movie screen. The copy made by this technique then is converted to video tape or DVD records, and the records are sold to the public and otherwise distributed, such as by way of the internet.

Video program counterfeiting usually is done by obtaining a legitimate copy of the program and copying it with the use of video capture cards or [other] means known for the purpose.

Attempts have been made in the past to stem the tide of such counterfeits. One such attempt, believed to have been originated by Kodak, is to provide a series of photographic slides, each with a different number on it. These slides have been used to record the number of the print on each motion picture film print as it is being printed. A small grid pattern representing the print number thus is projected on several separate frames of the print as it is being made.

In theory, when a counterfeiter makes a video copy of the film, the pattern also will be copied. Then, after the counterfeit has been distributed, it can be viewed by law enforcement personnel to determine which print of the film was copied. Hopefully, when that print number is traced to the theater or other location in which it was shown (quite often at

a preview prior to the formal release of the film) the counterfeiter can be identified as someone who had access to the screening.

The above-identified system has met with only very limited success, for several reasons.

One reason is that sometimes the code symbol would not be copied by the video camera because of the difference in the frame rate between the video camera and the motion picture film. The film is projected at a standard frame rate of twenty-four frames per second, whereas the frame rate for the video camera typically is thirty frames per second, unless the video camera used is a special camera, which is relatively expensive and only infrequently used by counterfeiters. Because of the difference in the frame rates between the camera and the film, some frames of the film were not copied because the shutter of the projector is closed when the video camera frame is being taken.

Another problem with this prior system is that some detail in the pattern is omitted from the copy due cropping, with the video camera not recording the full projected image on the screen.

A significant problem also is caused by the fact that a single pattern was used with variations in the location of elements of the pattern to represent different numbers.

For this reason, the code pattern is difficult to read. It often is necessary to use a template to manually apply to the symbol to determine the relationship of the individual elements in the symbols to one another in order to read them. This is relatively slow and unreliable, and is discouraging to those attempting to track and stop the counterfeiters.

Improvements have been made to the system described above. The slides have been replaced by other means to apply the coded symbols. Such means include an array of LEDs (Light-Emitting Diodes) to form the symbols.

Another improvement has been the repetition of the code symbol on two to four successive frames at each of several locations on the film so as to avoid the problem caused by the difference in frame rates between the motion picture film and the video camera.

However, the resulting system still leaves much to be desired. Prior to the present invention, it still has been difficult and unreliable in reading the code symbols.

In view of the foregoing, it is an object of the present invention to provide a coding and counterfeit tracing system and method which alleviates or solves the foregoing problems.

In particular, it is an object of the invention to provide a coding system and method which is easier and more

reliable to use, yet uses symbols which are harder for counterfeiters to find and delete, and yet unobtrusive to the viewer of the film.

It is a further object of the invention to provide such a system and method which is relatively quick, accurate and efficient to use.

It is an object of the invention to facilitate the rapid tracing of the source of counterfeit film copies, leading to the apprehension of those responsible.

In accordance with the present invention, the foregoing objects are satisfied by the provision of a coding system in which each separate digit of the number for each print of a motion picture film is represented by an individual unique code symbol which is recorded in a frame separate from the frames in which each of the other digits appears.

Also, each code symbol is composed of one or more very small images which are made to look like defects or artifacts in the film. They are so small and widely spaced that they are not usually noticeable to the ordinary movie patron, and yet are relatively easy to detect by the trained observer or by pattern recognition equipment.

Furthermore, each digit is repeated in successive frames within the film copy, once in a frame either immediately following the first frame or in a closely subsequent frame to

avoid the difference in frame rate problem, and at several different locations along the length of a motion picture film.

In addition, a record is kept of the location of each code symbol in the film print. Then, when a counterfeit copy is viewed, the record is used to aid the investigator in finding the symbols.

The foregoing makes it difficult for counterfeiters to detect every code symbol location and to erase all of the code symbols from the film copy.

Specifically, the code symbols can be comprised of a pattern of small, unobtrusive specks which are interspersed with the images appearing on the film so as to be unobjectionable to the viewer. The small specks look similar to small dirt particles, and thus are difficult to find, without knowing where to look.

Alternatively, each of the code elements can have a shape so as to resemble other defects or artifacts, an thus be more difficult for counterfeiters to find. For example, the element may look like a small scratch or color defect. The various types of code elements can be mixed within a single code or symbol, again increasing the difficulty of detecting and erasing them.

Also preferably, each of the marks is of the maximum size which is relatively unobjectionable to the viewer, while

being of a size larger than can be eliminated by data compression in a video transfer.

In certain prior proposals for video copy protection, noise has been embedded in the video signals in particular patterns to use in identifying the source. This has certain disadvantages, such as by requiring a substantial amount of extra hardware for use in recording the protected video copies.

Other so-called "electronic water-marking" schemes have been proposed and are not believed to have been successfully employed in solving the problems intended to be solved by the present invention.

In accordance with the present invention, the images appearing in specific pre-selected places in the video program are slightly altered so as to be essentially unnoticeable to the viewer. The presence or absence of an altered picture at each of a number of pre-selected locations forms a code which represents a unique number applied to that copy of the motion picture. The unique number then is recorded and stored, together with an identification of the person or entity who receives the copy when it is distributed, so as to enable law enforcement personnel to review suspected counterfeit copies of the motion picture to read the code number and identify the recipient of the copy and thereby track down the source of the counterfeit copies.

Preferably, the alteration of the images consists of slightly shifting an image such as by changing the aspect ratio of the image. It is preferred to do this by enlarging an image slightly so that one or more edges of the image is moved relative to the same edge in the video master. Sometimes an image boundary overlaps a boundary of the frame and becomes invisible.

This alteration procedure helps enforcement personnel to compare the frame of a suspected counterfeit copy with an unaltered frame from an unaltered master copy of the motion picture to determine which of the images has been altered. When the pattern of alterations is detected, this will indicate the number of the copy which has been counterfeited and will lead to the possible source of the counterfeit.

In a preferred embodiment, the alteration of images is applied to each frame of a complete scene. This makes the alteration very difficult to detect without access to the unaltered master video.

It also is preferable that each of the pre-determined locations for alterations consisted of a plurality of successive or separated scenes in order to ensure detectability of the alterations by enforcement personnel.

In accordance with another aspect of the invention, the code recorded by image alteration is combined with the

separate code provided by the method of recording small coded artifacts in each video copy, like those described above for use in film copies, so that enforcement personnel have two different codes to look for in identifying the source of a counterfeit and confirming the number of the copy which has been counterfeited.

In making video copies containing the codes described above, a particularly advantageous method is used.

First, a video copy with images altered at pre-determined locations is prepared. Then, the master video which has not been altered is played back in one playback device, such as a video server, while the altered version is played back on another playback device such as a second video server. The output of both servers is delivered to a video router which controls a large number of different video recorders to simultaneously prepare copies in relatively large quantities.

A random number generator is employed to generate an identification number for each copy, and the number so generated is used to control one output channel of the router so as to alternatingly deliver the master video signal and the altered video signal and thereby record the altered images in a particular pattern which gives that copy a unique identification number.

The code made of artifacts is added by modifying the output signals of the second video server, in copies using both forms of coding.

The foregoing and other objects and advantages of the invention will be apparent from or explained in the following description and drawings.

IN THE DRAWINGS:

Fig. 1 is an elevation view of a segment of motion picture film illustrating one of the code symbols of the present invention;

Fig. 2 is a schematic block diagram of an encoding system of the present invention;

Fig. 3 is a schematic block diagram of a code reading system of the invention;

Figs. 4-6 are representations of examples of defects or artifacts usable as code elements in the invention;

Fig. 7 is a top plan view of a code printing head of the invention;

Fig. 8 is a cross-sectional view taken along line 8-8 of Fig. 7;

Fig. 9 is an enlarged, broken-away view of a portion of the structure of Fig. 8; and

Fig. 10 is a right side elevation view of the structure shown in Fig. 7.

FIGURE 11 is a schematic view of several unaltered frames of video programs;

FIGURE 12 is a schematic view of the same frames as those shown in FIGURE 11, after alteration;

FIGURE 13 is a schematic view of a system used to perform the encoding and prepare uniquely encoded video distribution copies of a motion picture or other program; and

FIGURE 14 is a schematic view of another encoding method used in tandem with the method illustrated in Figures 11 and 12.

GENERAL DESCRIPTION

Fig. 1 shows a segment 20 of motion picture film in which one frame 22 bears a photographic image, represented by the line 28, and a coded pattern 30 representing an alphanumeric character. One full frame 22 and parts of two adjacent frames 24 and 26 are shown in Fig. 1.

Preferably, the pattern is made of a plurality of specks 32, 34, 36 and 38 in a 3X3 dot matrix, although patterns and code elements other than those described can be used instead, as it will be explained in detail below.

Although any desired information can be encoded, in this invention, it is preferred that the pattern represent one of the digits of the number of the film print of the motion picture in which the frames 22, 24 and 26 appear.

For example, the specks pattern shown may represent the first digit "2" of the print number "2379" which has been given to the print.

In accordance with one aspect of the invention, a different pattern in the matrix, one representing "3" is recorded at a substantial distance along the film strip from the frame 22, from say 10 to 100 feet away. Then, a third pattern representing "7" is recorded another substantial distance away, and a fourth pattern representing "9" is recorded after that.

Each of the numbers also is encoded in one or more other frames near the frame where that number first appears, so that each number appears at least twice in nearby frames, in order to defeat the problem of different frame rates causing missed recording in a video camera.

Preferably, each series of numbers is then repeated several times throughout the length of the film print; e.g., 20 or 30 times in a full length feature film.

Although the coded numbers can be located in a single 20-minute reel of a multi-reel feature film, it is preferred to locate the numbers in more than one or all of the reels, in order to make the counterfeiters' jobs of erasing the codes more difficult.

Fig. 3 shows a typical system used to detect coded patterns in a video copy made from a projection screen. The DVD

or VCR record is inserted into a player 54 which then shows the movie on a television receiver 56.

The specks 32, 34, 36, 38 are visible to the naked eye. Therefore, the print number can be read without any special equipment. However, reading is greatly aided by use of a stored record of where the codes are recorded in the film. With the aid of a time code reader and display unit 55, the investigator can fast-forward to the right locale in the tape or disk and search for the right frame.

In this way, the other digits of the print number can be read, the records kept showing the theater to which each print was sent will then identify the theater where the counterfeit copy probably was made, and the search for the counterfeiter is thus narrowed quickly.

The artifacts need not be circular. However, it is preferred that they look like specks of dirt. This prevents them from being too evident to ordinary movie patrons, and makes them harder to find by people who do not know where to look.

Advantageously, small marks other than dots can be used as code elements. Figs. 4, 5 and 6 show three such marks; a small scratch 62 in fig. 4; an elongated spot 64 in Fig. 5 and a color artifact 66 in Fig. 6. These can be used singly, or in combination with one another to further disguise the code

patterns. In fact, almost any mark which looks like a film defect can be used effectively as a code element.

The code recorder of the present invention, to be described below, also can be used to form alphanumeric characters. As it is shown in Fig 6A, it is used advantageously to form the print number "2379" on the leader 68 of the film. This makes it easy to check the code number against the print number visually during packing, shipping and other handling of the print.

RECORDING SYSTEM

Fig. 2 shows the system used to record the code elements on the film 20. The system includes a projector 40 for displaying the film during a preview in which locations for the codes are determined. Of course, the film can be converted to video tape first, if that is most expedient, and then displayed on a video monitor instead of the projector.

The locations of the code are stored in a personal computer (PC) 42 or a database. The computer 42 delivers control signals to a master control unit 44 used to control the printer in which the recording process is performed.

An encoder accurately reads the position of the printer sprocket and sends corresponding signals to the master control 44.

The code which is seen on the display (46) can be entered into the printing machine, manually or electronically through a network at the start of a printing operation. Afterwards, the master control unit 44 increments the print number automatically for every new print made.

The code images are recorded on the film 20 during the printing process when the film passes between a recording head 50 and a roller. The head 50 receives signals transmitted from a LED array contained in the master control unit 44 through a fiber-optic cable 49. The recording head records the received signals on the film 20 at the precise location directed by the master control 44.

The proper location of each code pattern in the proper location in the proper frame is done under the control of a program prepared by an operator during a preview of the film.

The operator runs the projector until a suitable location for the first code pattern is found. The pattern can be located anywhere where the appearance of minor artifacts is unobjectionable, usually in the upper half of the frame where the sky usually makes a good background.

If desired, specific patterns can be located in specific columns in order to facilitate reading the code.

Then, the first location is stored in memory for use during each printing run.

This procedure is repeated for each other code location until all of the codes and locations have been stored.

Then the printing process starts. The stored locations of the codes are read out and, under the control of the encoder 48, the codes are recorded as the print is being made.

When the next print is started, the print number increments by one, and the process is repeated.

RECORDING HEAD

Figs. 7-10 show the structure of the recording head 50.

Referring first to Fig. 7, the head 50 has a lens holder body 51 with an array 72 of light emitters and mounting holes 74. The light emitters are arranged in two parallel rows 76 and 78, and are staggered with respect to one another so that the emitters from one row are located to fill the spaces between emitters when film travels past the head in the direction of the arrow 73.

Each of the light emitters includes an inlet barrel 80 and an outlet 82.

As it is shown in Fig. 9, a spherical ball lens 86 is mounted in each outlet 82. A fiber-optic cable ferrule (not shown) fits into each inlet barrel, and the conductor end 88 (Fig. 9) delivers light from a LED to the ball lens. The lens

then focuses the light to reduce the size of the artifacts to be produced, as needed.

The film 20 is spaced closely to the ball lenses (about 15/1000 inch away) but does not touch them.

As it is shown in Fig. 10, the upper surface of the body 51 is curved so as to facilitate control of the spacing between the lenses and the film.

By controlling the timing of the operation of the LEDs, not only artifacts and whole numbers like those shown in Fig. 6A can be formed by the recording head, but scratches, spots, and marks of many other shapes can be formed.

VIDEO COPY PROTECTION

Figure 11 shows a series 100 of three successive frames 112, 114 and 116 from a single scene of a video program such as a motion picture.

Each frame contains an image of a square or block 126. It is moving from left to right and thus is shown progressively closer to the right edge of the frame as one moves from frame 112 to frame 116.

Figure 12 shows the same three frames of the video program shown in Figure 11 after alteration, in accordance with the present invention. The alteration, in this example, is an enlargement of the image by a relatively small amount, e.g., from less than 4% to 10%. The enlargement of the object 126 to

form the image 120 shown in the drawings is greater than that so as to more clearly illustrate the principle of the process.

In each of the altered frames 120, 122 and 124 the right edge 120 of the enlarged object 128 is closer to the right-hand border of the frame than the unaltered object 126 in the corresponding frame of Figure 11. In fact, in the right-most frame 124, the right edge 130 extends beyond the right edge of the frame and thus is not visible.

In accordance with a highly advantageous feature of the preferred embodiment of the invention, the same alteration of the images is applied to all frames of each scene in which alteration is applied.

The fact that a frame of the video program has been altered can be determined by viewing the altered frame in comparison with the same frame in the unaltered master video copy, such as by juxtaposing the two frames near one another, in the manner illustrated by Figures 11 and 12. However, it is believed to be very difficult for a counterfeiter to detect the alterations without having the unaltered master to compare the copy with.

This superior result is due, in part, to the fact that the same alteration is applied to every frame within the scene in which it is applied. Were this not done, a counterfeiter might be able to detect the alteration as a sudden change within

a scene and take steps to correct his counterfeit copy to eliminate it. Instead, the sudden change from one scene to the next masks the sudden change caused by the alteration.

Since it is relatively easy to keep the unaltered master out of the hands of counterfeiters, the encoding of the invention is very difficult for counterfeiters to detect and defeat.

VIDEO CODING SCHEME

A variety of coding schemes can be used to encode a unique identification in each video distribution copy of a program.

In the preferred coding scheme, 64 different locations in the program are pre-selected. The locations can be selected at random. The time code of each location is stored. Thus, during review of a suspected counterfeit, the master can be run to each code location and still-framed when the code location is reached. When the corresponding portion of the copy is found and still-framed, frames in the master can be compared with corresponding frames of the copy.

A random number generator is used to generate a unique combination of signals forming a digital one or zero at each of the 64 locations. If the images are unaltered at a location, that is taken to be a digital zero. If the images are altered, that is taken to be a digital one.

The number of genuine copies made of many programs, such as movies, usually is relatively low, e.g., in the hundreds or low thousands. A 64-unit code is not necessary in order to uniquely identify each such copy. However, by providing so many digits, distinct advantages are obtained.

First, there is no need to access the code at its start because virtually any sequence of 10 to 15 digits can be compared with the codes stored for the copies until a unique match is found. A match can be found quickly and easily using conventional computer software.

Secondly, a longer code sequence is harder to completely delete when making an illegal copy. Thus, it is more likely that enough code will survive the counterfeiter's effort to destroy it.

The alterations preferably are repeated in each of a plurality of scenes at each of the 64 locations in order to avoid the loss of code due to cuts or deletions made in the copy by the counterfeiter, either deliberately or accidentally. Also, it facilitates detection of alterations by enforcement personnel because the alterations may be more visible in some scenes than others.

In addition, if a scene is repeated at a location very near it first appearance, both of the appearances will be

altered and comparison of the two will yield nothing for the counterfeiter.

ENCODING AND DUPLICATION SYSTEM

Figure 13 is a schematic diagram of an encoding and video program duplication system 132.

The system includes a first video server 134, a second video server 136, a video router 140, a computer 142 with an input keyboard and screen 160, with a storage unit 144, and a plurality of video recorders 150, 152, 154, 156, etc., for making distribution video copies.

Although it does not take part in the production of copies, also shown in Figure 13 are an image processor 148 which is used to alter the images output from the server 136 in accordance with instructions received from the computer 142.

The unaltered master video is stored in the first or "master" server 134, and the altered video is stored in the second or "modification" server 136. The altered video preferably has altered scenes at each of the 64 locations selected randomly by the computer 142.

Signals from the unaltered master video are sent from the master server 134 to the router 140 while altered video signals are sent from the modification server 36 to the router 40 in synchronism with the master video signals.

The video router 140, as it is well known, has the ability to switch rapidly back and forth between two input video signals to produce on each of a large number of output terminals 58 a unique video signal which is made up of signals from each source alternating with signals from the other source.

The computer 142 contains a random number generator which is used to generate a unique 64-digit random number which is assigned to and stored for each of the output terminals of the router.

Each of the recorders 150, 152, etc., has a unique bar code identifying it. Each blank DVD or tape on which the program is recorded also has a bar-code identifying it. These bar codes are read by the use of bar code readers 162, 164, 166 and 168, and associated with one another and stored in memory (e.g., a disk file) 144.

The random number code also is stored and associated with the bar codes for recorder and the record. Similarly, the identification for the recipient of each copy is stored and associated with the copy identification.

The time codes for the 64 locations are stored once for each program and made available to enforcement personnel in order to check a suspected counterfeit.

It should be understood that the alterations to the images can take forms other than enlargements. For example, the

images can be enlarged in one dimension only instead of in both height and width, images can be slightly reduced in size in both or only one dimension, etc.

SECOND CODING METHOD

Although the foregoing method can be used alone, it is preferred to use, as a second coding method, the method described in detail above using artifacts in the images,

Fig. 14 shows a segment 170 of a motion picture video master in which one frame bears an image, represented by the line 178, and a coded pattern 180 represents an alphanumeric character. One full frame 172 and parts of two adjacent frames 174 and 176 are shown in Fig. 14.

Preferably, the pattern is made of a plurality of very small dots 182, 184, 186 and 188 in a 3X3 dot matrix, although patterns and code elements other than those described can be used instead, as it will be explained in detail below.

Although any desired information can be encoded, in this invention, it is preferred that the pattern represent one of the digits of an identification number which is assigned to each video copy. Preferably, this is a 5 digit number starting with 00001 and increasing by one for each additional copy made. Thus, if 128 recorders are connected to the router 40 during a production run, the numbers used will be 00001 to 00128. In the

second production run, the numbers assigned will be 00129 to 00257, etc.

For example, the dot pattern shown may represent the first digit "0" of the number "01736" which has been given to the copy. Similarly, a different dot pattern is used to represent the "1", the "7", and each other digit in the number.

During a record production run, the modification server 36 begins by generating the pattern for the number "0" in the first "placeholder" location. This pattern will appear for two film frames, immediately following an edit.

Locating a pattern immediately following an edit makes the dots harder to see. The patterns can be generated at any edit point throughout the program with the exception of edits within modified scenes; that is, within scenes in which the images have been altered as described above.

There are ten specific locations for each of the numbers 0-9 at the first placeholder location, ten more specific locations at the second placeholder location for the second number, then more at the third placeholder location, and ten more at each of the fourth and fifth place holder locations.

Each of the specific locations is selected by the computer, and its time code is stored. Thus, if a pattern is found at a particular time code position in a suspected counterfeit program, it will not be necessary to be able to read

the pattern; it will be known what the number is simply by its location. Of course, its place in the identification number (that is, whether it is the first, second, third, fourth or fifth digit) also is known, from the stored time codes.

In the production of a batch of copies (e.g., 128 copies), the modification server 136 first generates the pattern for the number "0" in the first placeholder position. All recorders that have been assigned the number "0" in the first placeholder position will now be switched by the router to receive an input feed from the modification server 136.

Next, the modification server 136 will generate the number "1" for the first placeholder. Once again, any recorders requiring the number "1" in the first placeholder will now be switched to the output of the server 136.

In this fashion, the system steps through all of the numbers in all of the placeholders; 0 to 9 in placeholder number 1; 0 to 9 in placeholder number 2, etc., until the patterns forming all the numbers to represent a different five-digit number for each copy have been recorded.

The numbers generated for each placeholder will not exceed what is required before moving on to the next placeholder. In the example "01736", there is no need to generate anything higher than a "1" in the second placeholder.

This process is repeated anywhere from 5 to 10 times throughout the duration of the program, depending on the run time of the program. Thus, the coded copy number is repeated 5 to 10 times during the program. This protects against destruction of the code patterns which frequently occurs due to data compression or deliberate destruction by the counterfeiter.

Preferably, the artifacts forming each code are formed by altering specific pixels of the video picture signals being transmitted from the second server 136 (Figure 13). This can be done by simply reducing the luminance level to zero in a few pixels to form small dark dots, by controlling the video color level of the pixels on the video card's output board in the server 136. Preferably, this is done by programming the server 136.

Pixel luminance and chroma values may be brought to zero or any other level greater than zero. For example, it can be desirable to subtract a predetermined luminance value from the existing luminance value of the pixel. The amount to be subtracted is the minimum amount required to enable enforcement personnel to see the dots in a pirated copy. In this method, no more pixel level change is used than is necessary, and this makes the pixels less obvious. Similarly, colors can be used to create the necessary marks. For example, a combination of

luminance and color can be used to create the color brown, which is less obvious than black.

In other words, the contrast between the artifact and the program material is made just high enough to make the artifacts visible to enforcement personnel who know where to look.

The dots 182, 184, 186, 188 are visible to the naked eye. Therefore, the print copy number can be read without any special equipment. However, reading is greatly aided by use of a stored record of where the codes are recorded in the film. With the aid of a time code reader and a video display unit, enforcement personnel can fast-forward to the locations in the program wherein the coded frames are located, and still-frame the codes frames for reading.

In this way, the other digits of the program code number can be read, and the records kept showing the entity or person to which each copy was sent will then help to quickly narrow the search for the counterfeiter.

The dots need not be circular. However, it is preferred that they look like specks of dirt. This prevents them from being too evident to ordinary movie patrons, and makes them harder to find by people who do not know where to look.

As it is explained in greater detail above, small marks other than dots can be used as code elements. Small marks

which look like small scratches, elongated spots or color artifacts can be used

When both encoding methods are used, enforcement personnel can use one method to check the accuracy of the other, or can select which one is easiest to read in a given counterfeit copy.

The above description of the invention is intended to be illustrative and not limiting. Various changes or modifications in the embodiments described may occur to those skilled in the art. These can be made without departing from the spirit or scope of the invention.

WHAT IS CLAIMED IS:

1. A method for uniquely identifying a plurality of copies of an audio-visual program in an electronic or optically recorded form, said method comprising:

(a) Altering images appearing at selected ones of a plurality of different locations in said program; and

(b) Selecting said ones of said locations in each of said copies to create a unique pattern in each of said copies.

2. A method as in Claim 1 in which said altering step comprises shifting an image in at least one frame in each of said selected locations.

3. A method as in Claim 1 in which substantially all of the images in a scene are altered at each of said locations.

4. A method as in Claim 1 including distributing said copies to a plurality of recipients, recording the identity of each of said recipients, and storing the patterns of each copy distributed to each of said recipients.

5. A method as in Claim 1 including the step of introducing artifacts forming an encoded symbol in each of said copies at further selected ones of a plurality of other locations.

6. A method as in Claim 5 including storing the locations of said artifacts for each of said copies and storing the identification of the recipients of each of said copies.

7. A method as in Claim 5 in which said artifacts are introduced at locations immediately following an edit.

8. A method of tracing the source of a counterfeit copy of a video motion picture, comprising an identification method as recited in Claim 1 including the step of comparing a suspected counterfeit copy with an unaltered master to detect which images have been altered.

9. A system for copy coding motion picture copies, said system comprising:

(a) apparatus for making multiple copies of said motion picture, and

(b) a computer-controlled device for providing a visually detectable indication at each of a plurality of selected locations in each of said copies, said locations being selected so as to form a coded pattern unique to each copy.

10. A system as in Claim 9 in which said motion picture copies are selected from the group consisting of film copies and video copies.

11. A system as in Claim 9 in which each of said detectable indications comprises a shifted image in a frame of the motion picture.

12. A system as in Claim 9 in which said coded pattern is a digital representation of a number unique to the copy in which it appears.

13. A moving picture security code application system comprising:

(a) code symbol recording equipment for recording code symbols on motion picture film; and

(b) a control system for controlling said recording equipment to cause it to record on said record medium information comprising a plurality of separate coded symbols, each being recorded in a separate frame of said moving picture.

14. A system as in Claim 13 in which each of said code symbols is located in a visible portion of said frame, said symbol comprising one or more small marks which look like defects.

15. A system as in Claim 13 in which each of said symbols comprises a representation of one digit of a multi-digit print identification number, and a unique identification number is provided for each of a plurality of prints of a moving picture.

16. A system as in Claim 13 in which each of said symbols is composed of one or more small marks made to look like a defect selected from the group consisting of dirt or dust particles; scratches; and color defeats.

17. A system as in Claim 13 in which each of said symbols comprises an array of visible specks representing one digit of a print identification number, said dots being large

enough to avoid their eradication by the compression means used in a video camera used to make a copy of the program on said film when projected onto a motion picture display screen, but small and spaced apart so as to be essentially, unnoticeable by an ordinary viewer of the film, each of said symbols comprising a selected combination of specks from a dot matrix.

18. A system as in Claim 13 in which said recording equipment includes fiber-optic cables with an exit focusing lens and a controlled light source for sending light through selected ones of said fiber-optic cables to record a pattern of light spots on said record medium and thereby form one of said symbols.

19. A system as in Claim 18 in which said recording equipment includes means for synchronizing the formation of said spots with the movement of said record medium through a copy recorder for recording the moving pictures on said record medium.

20. A method of counterfeit detection comprising the steps of:

(a) recording within a motion picture film copy an identification number of the copy, said identification member comprising a plurality of digits, each recorded in code form in the visible area of a different frame of said film, said

different frames being spaced from one another along the length of said film;

(b) keeping a record of the identification number for said copy and the destination to which it was delivered;

(c) viewing a suspected counterfeit copy of said film and determining the copy identification number recorded in said suspected counterfeit copy; and

(d) tracing said copy to said destination to which the copy was delivered.

21. A method as in Claim 20 in which each of said digits is in the form of marks forming a pre-selected pattern, each of said defects being as small as possible without making them invisible to the naked eye or being erased by the data compression of a video camera used to copy the motion picture.

Application No: GB0419956.8 **Examiner:** Miss Ceri Witchard

Claims searched: 1 and 9 **Date of search:** 9 February 2005

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1 and 9 at least	EP 0899688 A2 FUJITSU LIMITED See whole document, especially paragraphs 82-86.

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

H4F

Worldwide search of patent documents classified in the following areas of the IPC^{07}

G06T; H04N

The following online and other databases have been used in the preparation of this search report

Online: WPI, EPODOC, JAPIO

24